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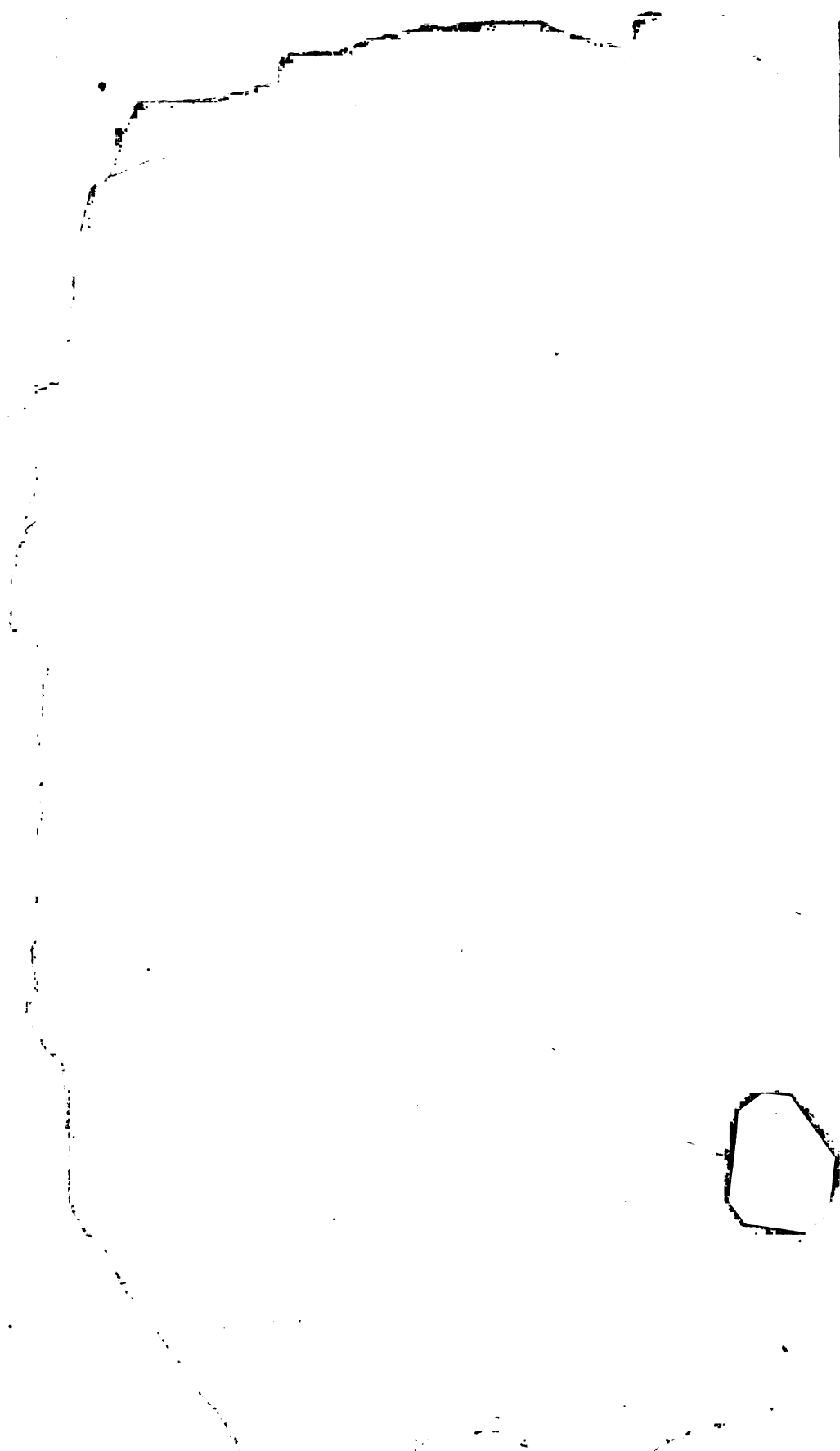
HYGIENIC REQUIREMENTS  
OF  
SCHOOL FURNITURE.

49,717.

BY  
G. A. BOBRICK, CIVIL ENGINEER,  
150 NASSAU STREET,  
NEW YORK.  
1892.

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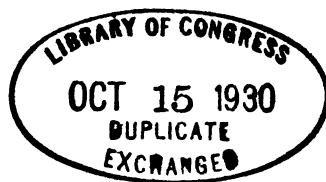
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## INTRODUCTION.

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THE subject of the hygienic requirements of school-rooms, and of school furniture, has been engaging the attention of scientists, physicians and teachers for the last half century, during which time numerous reports before educational societies, and articles in magazines, have been accumulating, both in this and in other countries. But, as yet, so far as the author of this treatise is aware, no publication exists that treats the whole matter comprehensively; and, in presenting to the public his own views on one branch of the subject,—that of the proper construction of school furniture,—he thinks he is rendering a service to teachers, school committees, parents, and all interested in the physical well-being of the young, by indicating the scattered sources from which information on the subject may be had, and by quoting at some length whatever has seemed to him of value in publications alluded to.

To one unfamiliar with the subject, the dangers pointed out in the following pages as likely to arise from defective school-rooms, and more particularly from improperly adapted furniture, may seem purely imaginary, but he will probably be surprised when he sees the long list of writers who, like the author, believe these dangers to be real. Independently, however, of all preconceived opinions on the subject, when we reflect that, if we only begin in infancy, the human frame can **purposely**

## INTRODUCTION.

**and by design** be, on the one hand, contorted and disfigured to almost any possible extent, as witness Chinese feet, flat-headed Indians, and acrobats as supple almost as India rubber ; or, on the other hand, moulded to almost any perfection of form, as shown by Greek and Roman athletes, does it not behoove all who have the charge of rearing young children, to adopt every device that will guard them from **involuntary** injuries at school, where they pass much of their time, whether arising from rooms, light, furniture, heat and cold, or ventilation ? The subject is a broad one, and merits all the study and attention that has been or can be given to it.

# HYGIENIC REQUIREMENTS

— OF —

## SCHOOL FURNITURE.

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EVERY ONE is aware that the bodies of children are easily affected by external influences. "As the twig is bent the tree is inclined," is no less true of children than of plants. An ignorant parent will be delighted to see his infant child walking at an age when he should be creeping; but he learns later, perhaps, that this precocity has made his child bow-legged for life. Near-sightedness, which once was rare, has now become prevalent and is increasing to-day, although the cause of it in many cases has been ascertained and a remedy provided. Round shoulders, curvature of the spine, difficulty of respiration, distortion of the upper part of the body, and

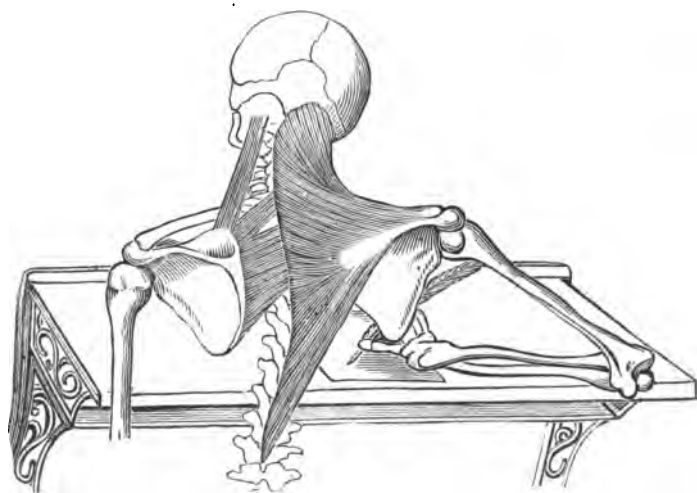


Figure 1.

other physical deformities which mar the symmetry of the frame, frequently make their appearance among growing children, and, if the cause be not discovered and removed, the

adult may bear through life a misshapen form, when in infancy he may have had a perfect one.

These evils not long since attracted the attention of scientists in Europe, who made a study of them and found that in most cases they are traceable to the use,—while the body is yet unformed and susceptible to all external influences,—of desks and seats, in school and at home, that are not properly



Figure 2.



Figure 3.



Figure 4.

adapted to the height and size of the pupil. In every class of a school the pupils vary as much in stature as they do in intelligence. They are classified as to the latter; but, tall or short, stout or slight, all members of the same class are made to occupy desks and chairs of the same general make,—too high and large for some, too low and small for others; what wonder, then, that the above-mentioned results are of common occurrence!

The subject itself has received greater notice abroad than in this country ; although, singularly enough, it was an American named **Barnard** who, in 1854, first called attention to the various physical defects before cited, and attributed them to the desks and seats used by children in schools. Whether it was due to his suggestion, or that the subject spontaneously engaged European attention at the same epoch, there soon after appeared in the Swiss, German, French, English and Russian literature and periodicals, articles on the same subject by the following eminent writers : **Francis Fonk** (1854); **Dr. Schreber**, of Leipsic, Saxony (1858); **Dr. Schraube**, of Halle, Prussia (1859); **Lanze**, of Brunswick, Germany (1862); **Dr. Passavan**, of Frankfort-on-the-Main, Prussia (1863); and **Freihang**, of Leipsic, Saxony (1863).

A very important article by **Dr. Farner**, of Zurich, Switzerland, in 1863, contributed to swell public interest in the subject, and call out further contributions. Among the later articles are especially notable those of **Dr. Hellem**, of Neufchâtel, Switzerland; **Prof. Meyer**, of Zurich, Switzerland; **Dr. Paroff**, of Berlin, Germany; **Dr. Cohn**, of Breslau, Prussia; **Dr. Hodgins**, of Toronto, Canada (1876, 1886); **Dr. Dukes**, of London, England (1887); **Dr. Newsholme**, of London, England (1887); **Dr. Carpenter**, of London, England (1887); **Dr. Eris-mann**, of St. Petersburg, the present Professor of Hygiene in the University of Moscow, Russia; and many others.

In this country the subject of "School Hygiene" has received the attention of many able and eminent scientists and physicians, and a large number of books, pamphlets and reports have been published, and lectures delivered, in which the questions of school furniture and ventilation are discussed.

Among the most notable articles are those of **Professor Bowditch**, of Harvard University, Cambridge, Mass.; **Dr. Frederick Winsor**, of Winchester, Mass.; **Dr. Geo. L. Rice**, of North Adams, Mass.; **Dr. Burnham**; **Dr. Wight**, of Win-

chester, Mass.; Dr. Geo. Derby, of Boston, Mass.; Dr. J. C. V. Smith; Dr. C. W. Williams, of Boston, Mass.; Dr. Abbott, of Wakefield, Mass.; Dr. Woodward; Dr. E. G. Loring, of New York; Dr. R. H. Derby, of New York; Dr. Risley, of Philadelphia, Pa.; Dr. J. D. Philbrick; Dr. A. W. Calhoun, of Atlanta, Ga.; Dr. W. T. Harris, of Concord, Mass.; and others.

From the report of the United States Bureau of Education we learn that in 1889\* the population of the United States was 60,971,114. In the school-year of 1888-89 there were in the 216,330 public schools of the United States 12,325,411 † children. Add to these the number of pupils in the incorporated academies and the private schools (1,401,163), and the number of pupils in the evening and business schools, schools for the defective, dependent and the delinquent classes (288,280), and we have an aggregate of 14,014,854 pupils at school. That is to say, nearly one-fourth (23.1 %) of the population are at school, and subject to the physical as well as the mental influences of school-life.

To investigate the hygienic influences of this occupation of school-going, and offer suggestions as to the means of improving these influences, is a public duty.

* 1890, Population of the United States,	-	62,622,250 (increase, 1,651,136)
† 1890, Pupils in the Public Schools,	-	12,697,196 (increase, 371,785)
1889, Population of the United States,	-	60,971,114
“ Pupils in Public Schools (Primary and Grammar),	-	11,809,259
“ Pupils in Public High Schools,	-	482,000
“ Pupils in Public State and City Normal Schools,	-	23,082
“ Pupils in Public Universities and Colleges,	-	11,070
“ Pupils in Private Schools (Primary and Grammar),	-	1,122,000
“ Pupils in Private Academies, etc.,	-	186,461
“ Pupils in Private Normal Schools,	-	4,487
“ Pupils in Private Colleges for Women only,	-	14,917
“ Pupils in Private Universities and Colleges,	-	41,549
“ Pupils in Private Schools of Science, Theology, Law, etc.,	-	31,749
Total number of pupils in Public and Private Schools,	-	13,726,574
(equal to 22.51 % of the total population of the United States.)		
Total number of pupils in Evening and Business Schools, etc.,	-	288,280
Total number of persons receiving an education,	-	14,014,854
(equal to 23.1 % of the total population of the United States.)		

It must be considered, that this one-fourth of our population whose occupation is under investigation, are all in the growing, formative, susceptible stage of life, not only most readily, but most permanently affected by every influence to which they are subjected. Without doubt the instinct of childhood is for frequent, almost constant, change of position and interest during the waking hours, and any steady occupation within a restricted space, may be fairly termed unnatural for children. But since the vast majority of children cannot have an "education," without some degree of violation of what may be termed the normal conditions of childhood, and since some education is a necessity, it becomes of the first importance to maintain a constant, jealous watch over the health of school children, and to persevere in the attempt to harmonize school methods and influences with the healthy instincts of childhood. Confinement, vitiated air, enforced quiet, prolonged mental effort, the use of the eyes on small objects in trying arrangements, are all, in some degree, conditions necessary to school, but threatening danger to the

## SUMMARY OF PUPILS BY GRADE.

Elementary, - - -	12,981,259 (number for each 100 of population, 21.21)
Secondary, - - -	668,461 (number for each 100 of population, 1.09)
Superior, - - -	126,854 (number for each 100 of population, 0.21)
Number of persons of school age (years 6 to 20), - - -	20,736,179
(equal to 34 % of the population.)	
Number of children of school age (years 6 to 16 inclusive), - - -	15,852,490
(equal to 26 % of the population.)	

67 % of the youth from 6 to 20 years, or 90 % of the youth from 6 to 16 years, inclusive, attend school.

In 19 years the value of property owned for public schools increased from \$130,383,008 to \$323,573,532, or more than twice as fast as the population.

During the same period the annual expenditures for the maintenance of the public schools have risen from \$63,396,666 to \$132,129,600 (an increase of from \$1.64 to \$2.16 per capita of population).

Total annual expenditures for educational purposes (public and private), \$171,739,317, equal to \$2.82 per capita of population.

Annual cost of education, in the public schools, for each pupil in attendance, \$16.51.

Number of male teachers in the public schools (1889) 124,929; number of female teachers 227,302; total, 352,231.



health of the scholars. To reduce this to a minimum, and there maintain it, is the duty of those who have charge of the rearing of children.

No subject within the scope of investigations can be of greater importance to the country, or of more vital and anxious interest to every family in it, and since the public interest in the schools is so warm, and the public assurance of their immense value is so complete, as to cause a natural jealousy of any criticism of them, lest it should prove a cover for an attack on our school system which might in some way impair its usefulness, it may not be inappropriate at the beginning of this inquiry to state that there is about it nothing of hostility, and that its aim is to make an impartial investigation. Like every other occupation, school-going must have its liability to peculiar hygienic disadvantages. Let us seek to discover these, and also the means whereby they may be reduced to a minimum.

Some time ago, the State Board of Health of Massachusetts took up the subject of "School Hygiene," and instructed their secretary, Dr. Geo. Derby, to send out circulars to the correspondents of the Board, calling for information based upon personal observations.

Dr. Burnham, a very able correspondent of the Board, sent some photographs, illustrating the effects of position upon the spinal column of a pupil occupying a desk and seat which are in faulty relations to each other, and improperly adapted to the height and size of the occupant.

Accompanying the photographs Dr. Burnham sent a letter to the Board, of which the following is an abstract :

"My attention has been directed for several years to the effects of position in schools upon the spinal column. I was first induced to notice it in our high school girls, from the fact that they could be pointed out from grammar school girls of the same age by their awkward, stooping attitude and swing-

ing step, and I was led to trace it to some cause satisfactory with theory.

“While investigating the cause of so much awkwardness of position of the pupils while in their seats in the primary schools, where but little care is taken in the making of small seats, I noted some of the common attitudes of the children after they had been in their seats for half an hour or more,

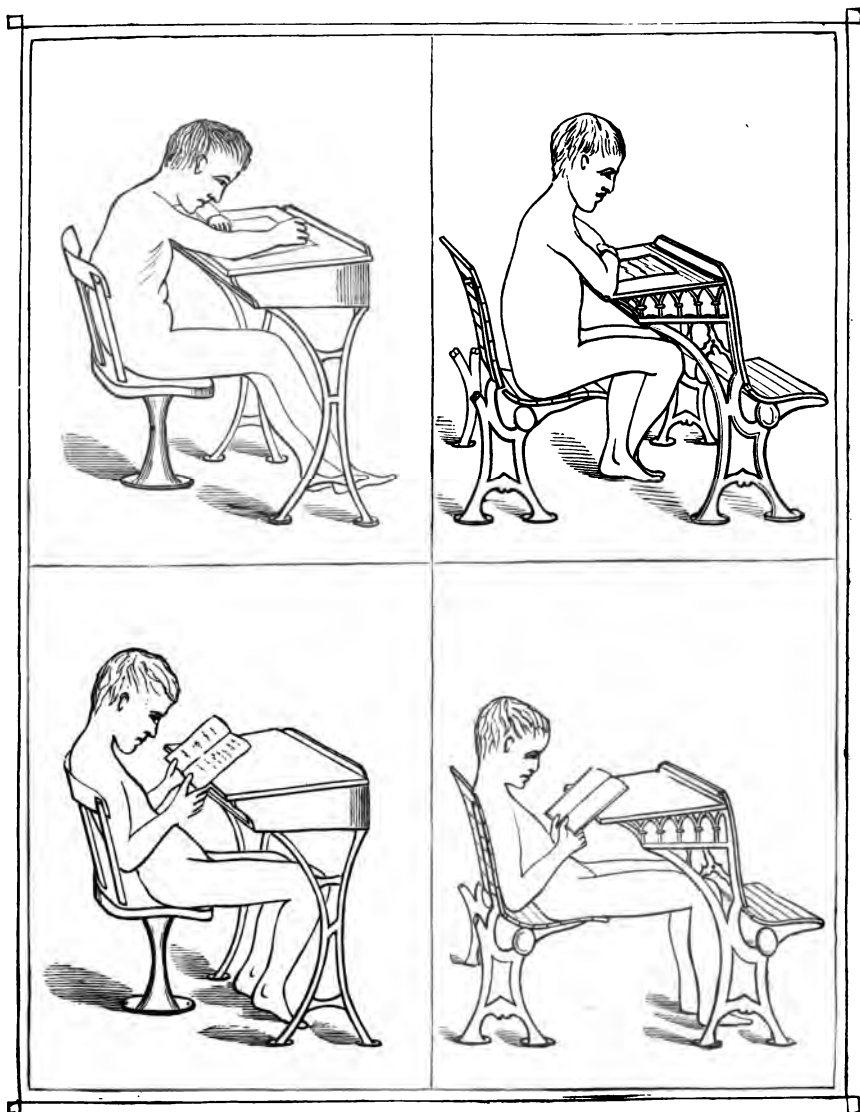


Figure 5.

and had a measure taken of their legs under the knee, and this I compared with the height of the chair.

“Now, in order to prove the effect upon the muscles, and also to show the curvature of spine, a boy twelve years old, well developed, was selected and photographed, without clothing, in several of these attitudes, thus showing every shade of pressure, and the effects upon the muscles,—not those under pressure, but more particularly those of the cavities, as the abdomen and thorax,—and the various curvatures of the spine. A well-arranged skeleton was also photographed, and, to our surprise, the same positions gave the same curvatures as in the boy.”

Figure 5 is a reproduction from Dr. Burnham's photographs. If copies of the above cuts, and a series similar, but giving other views, together with photographs illustrating the effects of any chair and desk when in faulty relations to each other, and improperly adapted to the height and size of the pupil, could be heliotyped and distributed at teachers' conventions, a most impressive practical lesson would be given on the importance of position and the use of properly adapted desks and seats.

“Were I of your profession,” says another correspondent of the Board, “I might be better able to reply sensibly to your query, viz.: ‘Do children suffer in health from school attendance, and whether the injury is most apt to fall on the osseous, the respiratory, the digestive, or the nervous system.’ My experience leads me to say that the osseous, so far as shape is concerned, will be badly affected by long confined sitting in one position, on unsuitable seats, and at ill-contrived desks. Very many schools in this State, notwithstanding its boast and self-adulation, are, in matters of furniture, ventilation, heating apparatus, general school means and facilities, plainly and unexaggeratingly speaking, a disgrace to civilization and a dishonor to Massachusetts. And I am free to say, that were some of the attention now given to push



Figure 6.



Figure 7.

of brain, by our educational supervisors of all degrees in State and town, given to these neglected demands, the brain would not only not lose thereby, but positively gain."

Dr. J. C. V. Smith calls attention to the radical defect in the seats of our school-rooms. Malformation of the bones, narrow chests, coughs ending in consumption, and death in middle life, besides a multitude of minor ills, have their origin in the school-room. To the badly constructed seats and writing-desks are we to look, in some measure, for the cause of so many distortions of the bones, spinal diseases, and chronic affections, now so prevalent throughout the country.

High and narrow seats, says Dr. Woodward, are not only extremely uncomfortable for the young scholar, tending constantly to make him restless and noisy, disturbing his temper, and preventing his attention to his books, but they have a direct tendency to produce deformity of his limbs.

Dr. J. G. Hodgins,\* in his treatise, "The School House, its architecture, etc.," says: "The problem of an easy seat and desk for a school-room is a very important one, which, like many other problems, has not yet received its only good solution."

Desks and seats constitute the main portion of the furniture of the room, and upon their form, construction and arrangement will depend much of the comfort of the pupils and the order of the school. It is now admitted as settled principles applicable to all schools:

1. That every pupil, whether old or young, should have a desk as well as a seat.
2. That both should be made as comfortable and as well adapted to their object as possible.

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\* Barrister-at-Law and Deputy Minister of Education for the Province of Ontario.

3. That the seats and desks should be so arranged as to permit each pupil to pass to and fro from his own, without disturbing any other in so doing. To these may be added

4. That the more neatly and substantially the seats and desks are made at first, the longer they will last, and the greater will be the saving to the school section in the end.

To render the seat and desk comfortable and convenient, both should bear a proper proportion, in height and form, to the size of the pupil; so that when seated his feet should rest firmly on the floor, and his arms should have easy action on the desk, without either raising them above the proper level for free use, or compelling him to stoop so as improperly to bend the body and contract the chest. The seat should in all cases have a comfortable back, and be slightly higher before than behind, so as to give a firm position to the person upon it.

It needs no argument to show that every pupil should have free access to his own seat. This is generally admitted with regard to the older scholars; but it is equally requisite in the case of the younger, who are more uneasy, and require to leave their places more frequently. This object can only be effected by the use of single, or at most double, desks—that is, desks at which no more than two pupils sit. The single desk would be the more desirable in all cases.

Each pupil should be provided with a seat and desk properly adapted to him, as to height and distance, giving the usual slope of one inch in the foot to the seat. The seats should vary in height from 9 to 18 inches, for children of different sizes—the smallest occupying the seats nearest the platform.

The seat should be so made that the feet of every child, when properly seated, can rest on the floor, and the upper and lower part of the leg form a right angle at the knee;

and the back of the seat should recline to correspond with the natural curves of the spine and the shoulders. The seat should be made as far as possible like a convenient chair.

The desk should vary in height from 19 to 31 inches ; for a single pupil it should be at least 2 feet long by 16 inches wide, with a shelf beneath for books. The upper surface of the desk should slope one inch in a foot.

In arranging the furniture of a school-room, the pupils should be faced towards a wall containing no windows, or if any, that they should have close blinds or curtains ; and that if possible this should be the north wall. It is also believed that the teacher's platform and desk should be across the end, and not the side, of the room, thus throwing the whole of the pupils more in front of him.

Seats and desks should never be allowed to touch the wall. If the size of the room will not allow a full passage next the wall, the desk should be kept at least six inches from it, both to allow the pupil near it the free use of his arm, and to keep him from contact with the damp, cold wall.

A great mistake has been made in some school-houses by seating them in such a way as to have all the pupils in the room face the windows. Such an arrangement cannot be otherwise than injurious to the eyes of the children, as the strong light is constantly shining into them. Pupils should always be seated with their backs or sides to the windows.

A pupil should never be assigned to a desk which does not correspond to his height. The desks in a school-room are usually so arranged that the smallest are in front of the room, near the teacher's platform, and the largest are in the rear. The scholars should be seated accordingly. The now practiced custom of assigning uncontrollable scholars, whether tall or short, to desks in the front or last row is a mistake, and should be abolished, if the desks and seats are not capable of regulation. While uncontrollable pupils do, at times, deserve to be punished,

yet no punishment should be inflicted which may leave a trace, in the shape of deformity, upon them.

In a school-house without recitation rooms, or with but one teacher, a sufficient space in front of the platform, for classes during recitation, is indispensable. It should be as large as possible, after making full allowance for the necessary passages. The full breadth of the room should be allowed for this purpose, if practicable.

Dr. Alfred Carpenter,\* in his treatise, "The Principles and Practice of School Hygiene," states: "Bad position in writing, drawing, and standing in class, or sitting upon a simple form, is a very prominent cause of deformity. Twisted spinal columns, malformations in chest, stooping habits and shuffling gait, with many kinds of bodily ailments, follow a want of knowledge by the teacher upon these points."

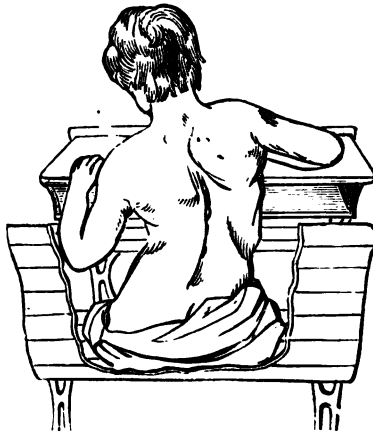


Figure 9.

This result is shown in Figure 9, in which the lateral curvature of the spine, and the tendency to stoop, with high shoulders and contracted chest, are shown. Not the least evil is the influence which this indulgence in a wrong position has upon the eyesight.

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\*One of the Examiners in State Medicine for the Universities of London and Cambridge; lecturer on State Medicine at St. Thomas's Hospital; and Vice-President of the British Medical Association.



The bad construction of the seats and desks in ordinary use in all schools has been a fruitful source of evil even in the great public schools of the country.

Children are allowed to bring the eye in close proximity to the paper or the book, to twist the spine so that one shoulder is brought down and the other elevated; the neck is so twisted that the axis of vision is perverted, and one eye being on a different level to the other, the set of muscles in use is not equally acted upon, so that one muscle gets to be stronger than the other. The axis of vision is irregular, and the child becomes more and more short-sighted.

The difference produced by book education, on the one hand, and athletic and muscular development, on the other, is seen between fox-hunters and sportsmen who are innocent of cram at college, or of college distinction, and those who have been studious. In the one case the sight is natural, in the other spectacles are generally used.

Desks must not be of an equal height for all children; they must be capable of regulation, so that a boy five feet high need not be obliged to sit at the same level as one four feet two. The taller boy has to stoop, or the shorter boy has to raise his head too much. The desk must not be too near or too far from the seat, and a flat desk is a mistake. The desk should incline slightly towards the child.

There should be always a fairly curved back to the seat, so as to prevent fatigue to the child, and its natural consequence, a curve of the spinal column in the direction not intended by nature. The seat upon which the child sits should not be a flat surface, but somewhat saddle-shaped. It is discomfort which leads to deformity, and every effort should be made to obviate this.

Every scholar should sit erect when writing, should keep the eyes in a parallel line with the surface of the desk, the

shoulders at an equal height, and the elbows close to the side, and not resting upon the desk itself. Weakly and delicate children should have a support for the whole of the back.

It will be conducive to excellence in the end, by producing a perfectly-fashioned figure, and preventing the formation of irregularly-developed muscles, which are visible in most people that we meet in the streets of a great city.

It is very important that the desk for a girl should be at least  $\frac{3}{4}$  of an inch higher than that for a boy of the same height. The height of the seat may be the same for both, boy or girl, but the width of the seating space (*i. e.*, the space between desk and back-support of chair) should be not less than  $\frac{5}{8}$  of an inch greater for the girl than that for the boy. It is the form and the dress of the girl that render it necessary to have greater space between the desk and seat, and the desk and back-support.

Dr. Bowditch, of Harvard University, U. S. A., has made some observations, based upon the measurements of 25,000 children, which were published by the State Board of Health of Massachusetts in 1877. He tabulates the growth of the scholars, and finds that it varies greatly in different periods of school life. That up to the age of eleven or twelve, boys are taller and heavier than girls. The latter then begin to grow more rapidly, and soon surpass the boys of the same age in both height and weight, but after thirteen the boys catch up with the girls and again surpass them. The relation of weight to height was found to be such that at heights below 58 inches, boys are heavier than girls in proportion to their stature; but that at heights above 58 inches, the reverse is the case. Local hygienic conditions have considerable influence upon the physique of growing children, and the sanitary condition of a community may be discovered by an examination of the children in the elementary schools of the district.

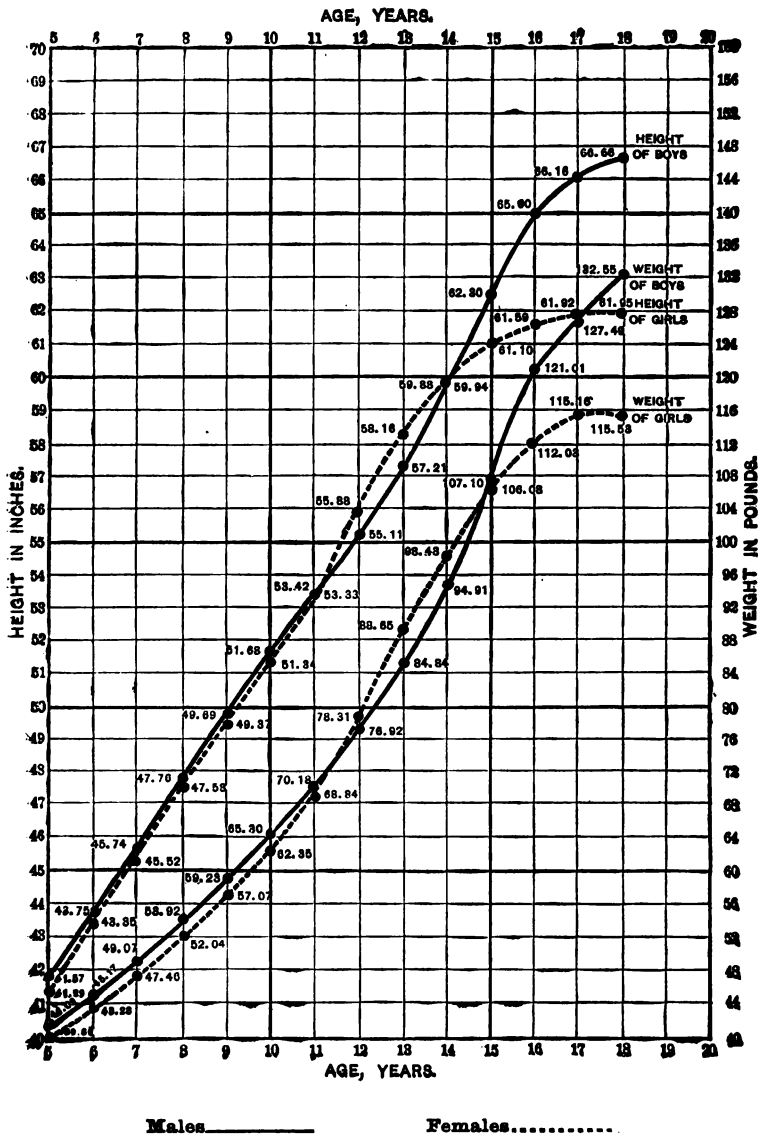
## HYGIENIC REQUIREMENTS

**TABLE** showing the average Height, Weight, and Growth of 13,691 Boys, and of 10,904 Girls in the Schools of Boston, Mass.—(Dr. Bowditch.)

Age last Birthday	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total No. of Observations.
Average Height of Boys	41.57	43.75	45.74	47.76	49.69	51.68	53.38	55.11	57.21	59.88	62.30	65.00	66.16	66.66	Inches.
" " Girls	41.29	43.35	45.52	47.58	49.37	51.34	53.42	55.88	58.16	59.94	61.10	61.59	61.92	61.95	
Average Growth of Boys	—	2.18	1.99	2.02	1.93	1.99	1.65	1.78	2.10	2.67	2.42	2.70	1.16	0.50	"
" " Girls	—	2.06	2.17	2.06	1.79	1.97	2.08	2.46	2.28	1.78	1.16	0.49	0.33	0.03	
Average Weight of Boys	41.09	45.17	49.07	53.92	59.23	65.30	70.18	76.92	84.84	94.91	107.10	121.01	137.49	132.55	Pounds.
" " Girls	39.66	43.28	47.46	52.04	57.07	62.35	68.84	78.31	88.65	98.43	106.06	112.03	115.53	115.16	
Average Increase, Boys	—	4.08	3.90	4.85	5.31	6.07	4.88	6.74	7.92	10.07	12.19	13.91	6.48	5.06	"
" " Girls	—	3.62	4.18	4.58	5.03	5.28	6.49	9.47	10.34	9.78	7.65	5.95	3.50	—0.37	
No. of Observations for Boys.	848	1,258	1,419	1,481	1,437	1,363	1,293	1,253	1,160	908	686	359	192	84	13,691
" " Girls.	605	987	1,199	1,299	1,149	1,039	936	935	830	675	459	353	238	155	10,904

# CHART

showing average Height and Weight of 13,691 boys and 10,904 girls in the schools of Boston, Mass.—(by G. A. Bobrick, from Dr. Bowditch's observations.)



Dr. Clement Dukes,\* in his treatise, "Health at School," London, 1887, states: "The question of seats in class-rooms is a matter of great moment, both as to their arrangement with regard to the light, and their height for the comfort and health of the pupil. It is important for the boy, but trebly important for the girl, and yet in most schools no attention is paid and the desks are improperly arranged."

The great defect in most schools for girls, says Dr. Dukes, is the utter neglect of physical education; whereas it should have a prior claim to their intellectual education, if there be any difference made at all. We need strong, healthy, vigorous women, and not fragile, fainting, insipid creatures; and yet no attempt is made to produce them, during the only years in which they can be produced—the years of their active growth and development.

The defect in the education of girls lies in the excess to which the practice of requiring lessons to be written out has been carried; for with improper seats, unsuitable desks, imperfect light, and several hours' continuous work, the pupils become so fatigued that they lounge over the desk or table, and a curved spine and prominent right shoulder result. In fact, it is difficult to find a girl without an abnormally curved back, one-sided shoulders, a prominent shoulder-blade, and a tilted hip.

The lateral curvature of the spine is not entirely owing to the causes above mentioned; it is partly due to the artificial support given to the spine during the growing years, and the general constraint of the modern dress preventing the muscles from having good healthy work to do and thus becoming strong and capable. High-heeled boots, too, not only cramp the feet, but deform them, and the spine and pelvis as well—an effect which cannot

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\* Member of the Royal College of Physicians of London, England; Physician to Rugby School; Senior Physician to the Hospital of St. Cross, Rugby; Howard Medalist of the Statistical Society of London.

be too strongly deprecated in growing girls, who are expected to become women and mothers.

Girls become knock-kneed and flat-footed, causing the most ungainly gait, in consequence of the way in which they are taught to sit and allowed to stand. This deformity of knock-



Figure 10.



Figure 11.

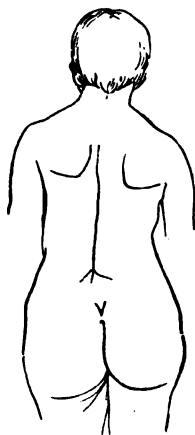


Figure 12.

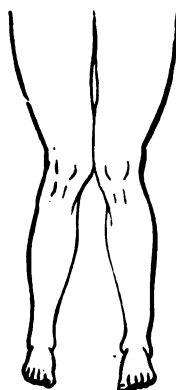


Figure 13.

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As these drawings were taken from life, they were more conveniently drawn from little children.

knee absolutely prevents a graceful or elegant carriage of the person, which is so much to be desired in girls.

For instance, girls are taught that it is unladylike to sit with their knees apart, and so they sit with their knees together and their feet apart, and with the result shown in Figure 10. When standing at lessons it is usually thus, and as each leg tires, it is rested in this position, producing knock-knee and flat-foot. (Figures 10, 11, 12 and 13.)

Such deformities of person need not and should not be; they would be unknown if more care were taken at school in developing the bodies of girls to the highest standard of beauty.

Dr. Arthur Newsholme,\* in his treatise, "School Hygiene, the Laws of Health in relation to School Life," 1887, states: "Desks and seats are the most important articles of school furniture, and it is unfortunate that authorities on this subject are not agreed as to their best form.

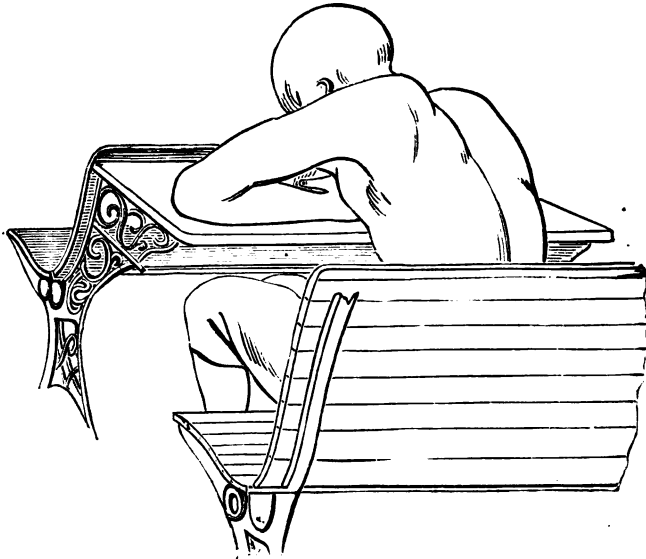


Figure 14.

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\*Diplomate in Public Health, University of London; University Scholar and Gold Medalist in Medicine; Medical Officer of Health for Clapham; Medical Examiner of Pupil Teachers to the School Board for London; and Medical Referee to the Westminster and Southlands Training Colleges for Teachers.

"Various bad forms of desks are met with. The desk may be too high, in which case, during writing, one shoulder is unduly raised in order to rest the arm on the desk, and a lateral twist of the spine results, which in time tends to become persistent. If the desk is too low, the scholar has to bend too far over his work. A forward stoop and round shoulders are produced; the head becomes congested from being held so low, and there is a strong tendency for the development of near-sightedness."

Dr. Jager, in 1861, first called attention to the remarkable development of myopia during school life. Dr. Cohn, of Breslau, took up the subject, and having examined the eyes of 10,060 children, he found 1,072 myopic, 239 hypermetropic, 23 astigmatic, and 396 whose vision was impaired from the effects of previous disease. As the testing was by lenses only, he probably underrated the myopia. In elementary village schools he found 1.4% of myopia, in town elementary-schools, 6.7%; in intermediate schools, 10.3%; in high schools, 19.7%; and in gymnasia, 26.2%. Among medical students he found the proportion in the first year of study 52%, in the last year 64%. At Tübingen, Dr. Gartner found that of 600 theological students, 79% were myopic.

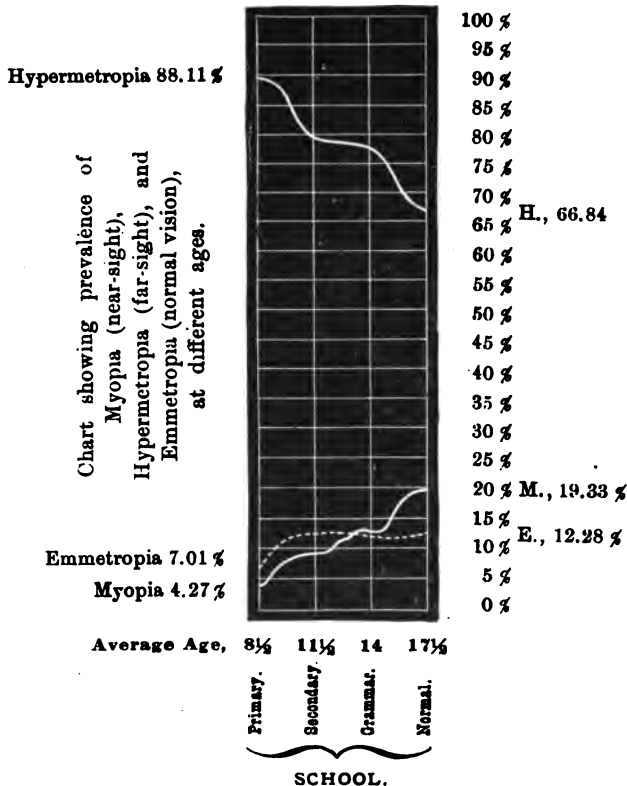
Although Germany has until lately had the greatest prevalence of defects of vision, it has by no means a monopoly of them. In all the cases investigated, the fact comes out that the youngest classes have the fewest myopics, and the oldest most. Drs. E. G. Loring and R. H. Derby, of New York, found that in the lowest classes 3.5%, and in the highest 26.78% were myopic.

The statistics furnished by the Philadelphia Committee, of which Dr. Risley was chairman, are peculiarly valuable, as a complete examination of the eye (barring the use of atropine) was made in each case. 2,422 eyes were examined by the committee, and 174 afterwards by Dr. Jackson, of West Chester, on the same plan, each case requiring on an average twenty-eight minutes' examination.



The accompanying chart (Figure 15) from Mr. B. Carter's pamphlet on "Eyesight in Schools," shows the result. The horizontal lines give the percentages, the vertical lines the different classes. The myopia was found to increase from 4.27% in primary classes (average age, 8½ years) to 19.33% in normal classes, while the hypermetropia diminished from 88.11% to 66.84%, the proportion of normal vision (emmetropia) remaining nearly stationary. It is evident from the statistics just advanced that school life has, under conditions which commonly prevail, a most deleterious influence on eyesight.

Figure 15.



Many defects and impairments of vision may arise and increase in childhood without giving alarm to children, or coming to the notice of teachers and parents, if they are unaccompanied by decided pain, as is the case in certain not

uncommon injuries to vision. And in regard to the frequency of such cases, we should give great weight to the opinion of oculists, and of that portion of general practitioners of medicine, whose attention happens to have been drawn to the evil in question. It may well be that other physicians and educators, whose experience covers very few cases of injury to eyesight from school-work, may not have had their attention called to a danger which really threatens many children whom they attend in sickness, because that danger is so insidious.

In order to be able to speak positively as to the frequency and degree to which eyesight suffers in school, we require extended and systematic observations with "test-type," such as have been made in Germany and in St. Petersburg, Russia, and reported in tabular form.

From the several causes which tend to produce defects of vision during school life, the following may be quoted from manuscripts and lectures delivered by some of our most distinguished professors and physicians :

Dr. Liebreich, in his lectures on "School Life," has shown that short-sightedness is developed almost exclusively during school life, by the use of improperly constructed desks and seats, in many cases by developing a pre-existing tendency, but in others where no predisposition is found, by actually producing the defect, so that the infirmity is continually on the increase.

Short-sightedness is not only in itself a direct inconvenience to the individual, but the efforts of the child during its growing years to assume a posture favorable to seeing, cause stooping and curvature of the spine, so that deformity and consequent ill-health are the frequent results. Besides this, by insufficient light and an inappropriate placing of the light, a diminution of acuteness and of endurance of vision is produced, and work in consequence has to be given up or diminished.

The question of eyesight is so intimately concerned with the construction of class-rooms, and their arrangements of lighting, together with appropriate desks and seats, that the subject must be referred to. The question of eyesight, as affected by education, is becoming a very serious national one. It is a fact, that children working under unfavorable conditions, are sustaining serious injury to their eyesight by the production of short sight.

Near-sightedness is also due to the prolonged exertion of the eyes involved in seeing near objects. School work usually lasts from four to six hours, and the home lessons sometimes nearly as long. During a great part of this time the accommodating apparatus of the child's eyes is being strained; the tissues of the eyes being soft and compressible, evil results are apt to occur, especially when there is hereditary tendency to defects of vision.

The posture of the scholar is very important. The desks and seats should be so constructed as not to allow the scholar to lean forward with a bent head. In writing we have a good instance of the principles involved, and the practice to be followed. The movements required are of a complicated character, and, like the complicated movements concerned in speech and walking, should be automatically performed. In fact, the more automatic and the less conscious the movements become, the greater is the degree of precision attained. Hence, as in piano playing, where the pupil is required to look at the music, and not at the keys, the pupil who is writing should be required to sit erect, and directly facing the desk, and should fix his attention on the matter to be written, rather than on the movement of his fingers.

The desk should be at a proper angle to the eyes, and the eyes should not be allowed to come nearer than twelve inches from the book or slate. Two feet of desk space in

length should be allowed to each pupil; the depth of the desk should be at least fifteen inches, and the seat twelve inches deep. The copy-book should be aslant, to allow for the bend in the writing, otherwise a twisted position is necessary.

A flat desk is particularly bad, necessitating a cramped position, and interference with free respiration.

If the desk is too far from the seat, a forward stoop, with round shoulders, flat chest, and injury to the eyes is produced.



Figure 16.

If the seat is too high, the feet swing, the vessels and nerves at the back of the legs are compressed, and the sensation of "pins and needles" is produced.

This is also very apt to occur if, as is commonly the case, the seat is too narrow to support the whole length of the thigh. If too low the thighs are bent up towards the body, and a cramped position is produced. If without a back-rest, or with an improperly adapted back-rest, the pupil tends to lean forward on the desk, thus preventing free expansion of the lungs.

An inadequate amount of light, or an ill-directed light, causes an undue strain on the eyes. The amount of window area required in a school-room is variously stated as from

one-fourth to one-tenth of the floor area of the room. Dr. R. Marus recommends to multiply the length, breadth and height of the room together, and to take the square root of this for the area of the windows. Dr. Cohn proposes that thirty square inches of glass (not including the window frames) should be allowed for every square foot of floor area.

It is evident that the amount of window-area required will vary with external conditions. Thus, in towns more should be allowed than in the country, and more in a narrow street than when there is an uninterrupted outlook. Also, more is required in the lower than the higher stories. Windows should always reach nearly to the ceiling, as the best light comes from the highest point, and much of the cheerfulness of a school-room depends upon the amount of sky which is visible. Plate glass is preferable, being thicker, and allowing less escape of heat. If the access of light is barred by an opposite wall, the wall should be painted or whitewashed. It is probable that the preparation of home lessons in semi-darkness is responsible for much injury to the eyes.

The makers of school books and the committees who choose these books have something to answer for in increasing the number of near-sighted eyes; but in this respect, American children are more fortunate, for their books are generally printed with much better type and on better paper than those issued in Europe.

Books for children should not be too large and heavy, the spaces between words and lines should be relatively wide, and the lines not too long. The type should be clear and large, Roman being much better than Gothic type. The construction of such letters as h and b, v and n, should be especially precise.

Dr. Cohn proposes that the type of ordinary journals should be 4 mm. or  $\frac{1}{8}$  inch in height, though M. Javal thinks it may

be allowed to be 2 mm. The thickness of down and up-strokes, the spaces between letters and words and between lines, and the length of lines, all require attention.

The following words represent well-known sizes of type :

<i>Double Pica.</i>		<i>Great Primer.</i>		<i>Pica.</i>
No type		smaller than		Pica should
<i>Small Pica.</i>	<i>Brevier.</i>	<i>Nonpa- rel.</i>	<i>Pearl.</i>	<i>Diamond.</i>
be used	while	teaching	children	to read.

**Ill effects of bad desks and seats.**—According to Eulenberg, a distinguished German orthopædic surgeon, 90 % of curvatures of spine, not caused by actual bone-disease, is developed during school life. Bad posture during school work, and especially the twisted position, with the left arm resting upon the desk during writing lessons, contribute considerably to the production of such curvatures. The effects are much more likely to be produced if the desk and seat are not properly adapted to each other, and to the height of the pupil. An upright position in writing is indispensable, and the left elbow should not be allowed to rest high up on the desk.

The cramped positions induced by defective desks and seats, not only favor the production of a twisted spine, but also round shoulders and flat chest, thus impeding the functions of heart and lungs. The habit of leaning forward close over the copy-book or reading-book will produce short-sightedness; and this in its turn increases the necessity for the improper postures. Thus a vicious circle is entered, each evil mutually intensifying the other.

Proper desks and seats should be accurately adapted to each other, and to the height and size of the scholar. The most important points to ascertain are: (1), the distance between the edge of the seat and a perpendicular line dropped from the edge of the desk; (2), the difference between the height of seat and desk, and the slope of the desk. The plumb line from the desk grazing the edge of the seat should be a negative quantity, so as to enable the scholar to write while sitting erect, or resting his back against the back of his seat. When the scholar is too far away from the desk, he either bends forward into an unnatural position, or slides too far forward on his seat, and occupies an unsteady position.

The difference between the height of seat and desk should not be such that the shoulders are painfully screwed up in writing, or, on the other hand, the pupil be obliged to lean forward in order to write or read. It is recommended that it should equal the length of the forearm, or about one-sixth the height of the scholar (Robson), in which case it will be found that the under-part of the fore-arm will rest comfortably on the desk-top.

The height of the seat should correspond to the length of the scholar's leg from sole of foot to knee, in order that there may be no stretching of muscles.

There should be a curved back to the seat, not less than three inches broad, slightly tilted back, and so placed as to support the back just below the shoulder blades. In this way the movements are not interfered with, while the spine receives steady support.

Long desks are, as a rule, objectionable; children tend to sit with the left arm high up on the desk, in order to prevent copying by their neighbors, and thus produce twisting of their spines.

Dr. Geo. L. Rice, a prominent physician and surgeon of Massachusetts, and a member of the School Committee of North

Adams, in speaking of the effect of improperly adapted desks and seats upon girls, says: "A chair or seat, not properly adapted to the pupil's size, is one of the principal causes of spinal disease (with consequent nervous troubles). It also produces a contracted chest, and in the female displacement of uterus; the last being induced by months and years of leaning forward to bring the eyes sufficiently near the desk before them. Of course, such displacements are attended by the usual life-time of trouble and pain."

Dr. A. W. Calhoun,\* in his paper read before the National Educational Association in July, 1881, on the effects of school work upon the eyesight of pupils, said:

"In the school-room there are two kinds of influence that work injuriously upon the eyesight. Under the first are classed all those things which compel the eye to strain itself in order to see distinctly small letters or objects; under the second, all those which cause a congestion or rush of blood to the head and eyes. To the first belong bad ventilation and improper light, too small and imperfect type, pale ink, etc. To the second—the construction and arrangement of school desks and benches, which, in many schools, make it next to impossible for pupils to hold their bodies in proper position for any length of time.

"Very little is being said in reference to desks and seats, though it would seem they deserve the most careful consideration on the part of those in charge of the education of children, since a large portion of a child's life is spent behind the one and upon the other. It has been contended that every pupil should have a desk to suit his size. The chief idea to be borne in mind in the arrangement of desks is that they should be so constructed that the children can sit without becoming too rapidly wearied, and that the desks should not be so low as to cause the

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\* Professor of Diseases of the Eye, Ear and Throat, in the Atlanta Medical College, and an eminent oculist of that city.



body to bend forward, nor so high as to make studying difficult, as in writing, for instance."

Says a well-known writer: "It seems to me that the very etymology of the word education enforces the idea that the child is to grow better and stronger up through his school life; that by proper regulation of his diet and management at home, by properly lighted school-rooms and **properly constructed desks and seats**, and by a better regulation of his hours of study, he should represent a much higher type of life when he has reached the age of twenty-five, than when he is just taken in hand with the view of giving him book knowledge. We certainly should not damage the eye in the process of education, and I believe that the damage done to the eye is to be taken as an index of that which is done to the other organs of the body. In conclusion, when every school-house in the land, and every school-room, and every school desk shall have been properly constructed according to the most scientific investigations, and plenty of good light thrown upon books properly and plainly printed with good ink; when the habits of study of all children shall have been regulated, both in the school-room and at home, then do I feel convinced that, while we may not be able to banish these particular eye diseases from the world, without doubt will we be able to reduce them in number and in severity."

Dr. C. H. Williams, in his lecture upon "School Hygiene," delivered under the auspices of the Massachusetts Emergency and Hygiene Association, to teachers in the public schools, says:

"Since all of our knowledge of books comes to us through the eyes, it is of the greatest importance to use every means to protect the eyes from injury, and to increase their usefulness.

"The greatest danger to the health and usefulness of the eyes, that comes from our present methods of education, is the alarming increase in the development of near-sightedness. This may be seen on a large scale among the Germans, for nearly 60 % of

their scholars over twenty-one years of age are near-sighted. The prevention of this condition is now occupying their most serious attention, for near-sightedness, or myopia, as it is more properly called, is not a mere inconvenience; it is caused by changes in the shape of the eyeball, and these changes are generally accompanied by diseased conditions of the internal parts of the eye, which tend to increase rapidly during the school years, and in extreme cases, may even lead to blindness. A strong tendency is also developed to transmit these changes from parent to offspring."

All authorities agree that the principal cause of near-sightedness is the long-continued use of the eyes on near objects during the years of most active bodily development, say from twelve to eighteen. At the age of eight there is very little myopia. Dr. Cohn found about 1 % among young German children in a village school. Drs. Loring and Derby found among the school children of New York, from six to seven years old,  $3\frac{1}{2}$  %; but as the children grow older, and use their eyes more constantly for book-work, the increase is very great. Dr. Conrad found among German school children of nine years, 11 % of myopia; at eighteen it had increased to 55 %; and at twenty-one years, to 62 %.

The following table of Dr. Cohn is especially instructive, for it shows not only the marked increase in the number of myopic eyes in the higher schools, but also the steady increase in the grade or amount of the near-sightedness in the different schools :

	Average percent- age of myopia.	Average amount of the myopia.
Country Schools, . . .	1.4	$\frac{1}{11}$
Primary " . . .	6.7	$\frac{1}{11}$
Intermediate " . . .	10.3	$\frac{1}{11}$
Polytechnic " . . .	19.7	$\frac{1}{10}$
Latin " . . .	26.2	$\frac{1}{9}$
Universities, . . .	59.0	$\frac{1}{2}$

In this increase of near-sightedness there is, however, one fortunate limitation, for after adult life has been reached, and

the school and college work has been completed, this increase of myopia generally comes to a standstill, unless the changes have already been extreme ; and if one has reached his twenty-first year without developing any near-sightedness, there is very little chance of beginning these changes, even with a large amount of near work. For instance, among watch-makers, jewelers, and others, whose occupation obliges them to use their eyes constantly at short distances, there is only a small proportion of near-sightedness ; but these men generally begin their special work after they have passed their eighteenth year, when the tissues of the eye and of the body have acquired firmness and maturity ; and also much of their work is done with the aid of a magnifying glass, which lessens the danger, and relieves to some extent the strain upon the ocular muscles.

While the eyes are well and strong we are apt to forget how very complicated a process reading is ; for the different muscles of the eye work together so quietly and without any voluntary effort, that it is only when we overtask them that we begin to discover the complexity of action. When a child reads a book, two sets of muscles are brought into play. With one set the power of the eye is increased by changing the shape of the lens, so that the rays of light from the book are brought to a focus properly on the retina ; by the other set the axes of the two eyes are turned toward each other, so that they are united at the point looked at, and with the eyes in this relative position, they are made to follow the lines of print back and forth across the page.

The popular idea that near-sighted eyes are stronger than others is a mistake ; it comes from the ability which they have to see small objects, such as fine embroidery, or print, with greater clearness than other eyes, owing to the work being held nearer the eyes, and the images on the retina being larger. Again, these myopic eyes do not have to put on glasses for read-

ing, at an age when other people require them, but this ability must not be presumed upon; for the strength of such eyes is only apparent, and no account is taken of the deeper seated changes which they have often undergone, or of the danger of more extensive complications which may result, in case they are abused.

In examining the children of some public schools in New York, Dr. Loring found that among those of German parentage, 21 % were near-sighted; those of American descent showed 19 %; and those of Irish parentage had only 14 %; while Dr. Calhoun found among 500 colored children 3.4 % myopic in one school and 1.2 % in another. These figures seem to show that the children of those nationalities where study and eye-work are most common, have the larger proportionate amount of myopic change; while those accustomed to the greatest amount of out-door life, and using their eyes almost entirely for distant things, are comparatively free from it.

Among the Germans the prevention of near-sightedness, or its mitigation, has been carefully considered, and the new schools with their many improvements have already shown a relative decrease of myopia among their scholars.

Careful attention should be paid to the construction of the desks and seats, their adaptability to the height and size of the occupants, and to the seating of the scholars at their desks, for not only is myopia caused by faulty positions and furniture, but some forms of spinal curvature may also be traced to this source.

The distance from the seat to the top of the desk should be two centimeters greater than the space from the elbow to the seat, when the arm is held at the side. The top of the desk should have an inclination and should project backward so as to overhang the edge of the seat by two or three centimeters. The seat should be raised above the floor the

length of the child's leg, measured from the sole of the foot to the underside of the thigh, when the knee is bent at right angles; it should be deep enough to support the whole length of the thigh, and should have a proper support for the back.

According to Dr. Fuchs, the scholar has a proper position when his body is vertical with pelvis, and shoulders parallel to the edge of the desk, and the head straight or only slightly inclined forward. The feet should rest on the floor, and the back be supported by a rest. In writing, only the forearm, and not also the elbow, should rest on the desk. In order to accomplish this, many sizes of desks, adapted to the different heights of the scholars, will be needed. But as it would be next to impossible, for those who have charge of the selection of school desks, to calculate on an average height of scholars, or to predict the number of scholars of one height or another, then the most desirable plan would be that recommended by Drs. Carpenter, Oldright, Guillaume, Rice, Calkins; and such practical men (members of School Committees and Superintendents of Schools) as Messrs. W. H. Burges, T. M. Balliet, J. F. Chapin, M. T. Pritchard, Frank Borden, Rev. Dr. R. J. Barry, and many others. These eminent scientists and gentlemen of education believe in, and advocate, a system of adjustable desks and seats, which could be regulated to suit scholars of any age, height or size.

The principle here insisted on involves a great change in our school methods, but by no means an impossible change. Let once the necessity of it be widely felt, and the reform "will get itself made," as has been wisely said. It need not involve a great increase of absenteeism.

Russia was among the first to take actual practical steps to introduce proper school furniture, and she appointed a committee composed of Professors, Teachers, Physicians, Scientists, Hygienists and Architects, their chairman being Prof. V. P. Kochanowsky, whose duty it was to investigate and report. This committee, aided by Drs. Erismann and Farner, were directed to ascertain, if possible, the exact manner in which ill-constructed desks and seats affect the eyesight and the forms of children, and to determine on such a construction of school furniture as would practically obviate the ill effects.

This committee appear to have made an exhaustive examination of the subject, to have ascertained the exact causes of the near-sightedness, curved spines, and the other evils before alluded to, and to have then set themselves to furnishing a remedy. They measured many thousands of pupils, studied their attitudes when at their desks, and concluded by compiling a table of details to be used in the construction of desks and chairs suited to all heights and sizes of pupils of each sex.

In their examination they found that scholars, while occupying desks and seats unsuited to their heights, involuntarily assume positions injurious to their healthy development and growth, and that such desks do, beyond all question, conduce to the evils before mentioned,—the fact being that no pupil can for any length of time occupy such a desk and escape ill consequences to a greater or less degree. They also found that the injury is caused during writing exercises by an enforced habit of bending the head forward or inclining it to the left, and during reading lessons by the pupils being obliged to bend the head downward.

In each of the above mentioned positions the centre of

gravity of the head was found to be diverted from its natural position over the spinal column, and the head, therefore, had to depend for its support on the muscles of the neck, kept thereby in a state of high tension.



Figure 17.

The fatiguing effect of such dependence on the muscles for support is strikingly evident when any one stretches out his arm straight from the body (say at an angle of about  $90^\circ$ ), and tries to hold it there nearly horizontal. The deltoid muscle is called upon for support; and, though at first it appears very easy to hold the arm thus, the fact is that no one can keep it so extended longer than about five minutes, as the weight of the arm soon overcomes the muscle power that supports it.

Now, the case is the same when the muscles of the neck and back are called upon to support the head of the scholar, which should undoubtedly be balanced by the muscles, but get its support by resting on the spine. These muscles, if called upon for an angular support, soon become fatigued, and in turn act forcibly on the ribs, which distend by being forced out from their natural position. As the fatigue increases the head droops, and the spinal column bends more and more as its leverage becomes

greater. The fatigue at length becomes so great that the pupil can get relief only by supporting his head on one or both hands, or by assuming some other still more unhealthy position.



Figure 18.

The ill effects of the struggle that thus goes on between the muscle power and the power of weight show themselves most conspicuously when the pupil leaves his desk and assumes an upright position. He finds himself stiffened and cramped, and invariably stretches himself as if recovering from a cramp, turning his head from side to side and lifting his arms with evident pleasure.

As this tendency, both in writing and in reading, to bend the head forward and to the sides, was shown to be so injurious, the committee endeavored to ascertain why it was that the pupil assumed these injurious positions, for if the cause were determined it might lead to finding a remedy. They ascertained that, in writing exercises, the pupils who occupied desks or seats that were either too high or too low, or with the back support



of the chair too near the desk or too far from it, did not see the points of their pens, and that, in reading exercises, they were obliged to lower their heads to see their books clearly.

In the opinion of the committee such positions are the cause of a struggle between the muscle power and the power of weight ; and as the muscle power can never overcome for any length of time the power of weight, such struggle ought to be avoided by furnishing desks and seats that will not necessitate



Figure 19.

any movement of the head, either backward or forward, or cause the pupils to lift their shoulders, rest their heads on their arms, or take any other unnatural position. Following the suggestion of **Prof. Meyer**, they finally decided that the only healthy position for the scholar to assume at the desk is to sit **upright**, with the centre of gravity of the body supported by the seat, exactly as the centre of gravity of the body is supported by one's feet while in a standing position ; that this position

required each pupil to have a desk and seat specially adapted to him in height and size, so that he should neither be crowded, nor have too much space in which to move, but enough only to enable him to sit in comfort and to change his position if requisite.

At the close of the report the committee recommended a new system and presented details for the construction of school desks and chairs, and this system has been adopted in many of the European schools.

Now, in this country very great attention has been paid to school furniture; and the American manufacturers of it build some four or six different sizes of desks and chairs,—a number, as they think, sufficiently large to cover all sizes that may ever be required. But an element of some difficulty needs to be considered here.

The system, to be wholly satisfactory, requires that each pupil shall at all times have a desk and seat that are suited to him. But the statures of young children are constantly changing from time to time; and, added to this, the entrance of new pupils and the departure of old ones, cause constant changes in the requirements of schools as to the height and size of their seats; so that a school may be fitted at the beginning of the school year with the proper allotment of the different sizes, and yet, by reason of the changes above indicated, this outfit may soon be imperfect. In such an emergency what is to be done? It will not do to let the pupils occupy desks that have become unsuited to them, and it would not be possible, except at great expense, to be continually changing the desks for new ones.

It is to surmount these difficulties, and to secure at all times for each pupil a desk and seat that will exactly suit him, that I was led to design a system whereby a desk and chair might be made to suit the height and size of any scholar.

In my designs I have closely followed the details recommended by the most prominent American and European scien-

tists, which I have compared by means of cross sections and profiles with those used by the American manufacturers of school furniture.

The accompanying cuts, with a brief description, will illustrate the desk and chair, and the plan on which they may be constructed.

The tubular standards of the desk and seat are made of cast iron. To insure a firm support on the floor, the standards are provided with round bases, 12 inches in diameter for the desk, and 11 inches in diameter for the chair. The central portion of the standard is provided with a socket, which receives the adjustable support or bar, *h*.



Figure 20.

This adjustable support or bar, *h*, is made of steel ( $1\frac{1}{8}$  inches in diameter) and is provided with a longitudinal groove or channel, *g* (Figure 20), and on the other side opposite it is cut a vertical row of notches, *k* (Figure 21), which do not, however, project beyond the solid parts of the bar. Fastened to the upper end of the standard is a catch, *l*, the inner end of which projects into the interior of the standard, so as to engage, under certain conditions, with the notches of the vertically movable bar or support, *h*.

That side of the standard which faces the longitudinal groove, *g*, is provided with two interiorly threaded bosses through which set-screws or binding screws, *m-m* or *n-n*, are inserted.



Figure 21.

The inner ends of the set-screws are provided with flat surfaces, so as to form right angles with the square groove of the support. These set-screws form the essential means by which the desk-top



Figure 22.

or chair-seat is permanently fastened in its adjusted position, and as a supplementary function, when loosened they prevent the desk or chair from turning during the process of raising or

lowering it. The notches, *k*, in conjunction with the retaining pawl, *l*, merely form a temporary hold (contributing, however, also to the permanent fastening) for the desk-top or chair-seat while being adjusted for a permanent position.

Now, if it is desired (we will say) to raise the desk-top or chair-seat (as the case may be), the binding set-screws, *m-m* or *n-n*, are loosened by a key applied to the square heads, so that the grooved support, *h*, will have some play or lateral motion in



Figure 23.

the socket. By now taking hold of the desk, it will automatically tilt backwards, so as to release the series of notches from the inner end of the catch, *l*. In this position the desk-top or chair-seat may be easily adjusted to any desired elevation, and by letting it go, it will (owing to the preponderancy of weight on one side) automatically and without any effort on the part of the operator tip back into such a position that the notches will interlock with the projecting inner end of the catch, *l*. By then tightening up the set-screws the movable supporting-bar, *h*, and with it the desk-top or chair-seat, will be firmly and permanently locked and held in its adjusted position, in which it will remain until occasion shall arise to readjust it, either up or down.

The seat is secured to a casting, which projects beyond the rear part of it, and extends downwardly in an oblique or inwardly slanting direction. Two brackets (one on each side) are recessed on their outer sides, to form ways which are adapted to receive the slotted arms of the chair-back.

The back support of the chair is adjustable in two directions, viz.: horizontal and vertical. The horizontal adjustment is designed for the purpose of setting the chair-back nearer to or

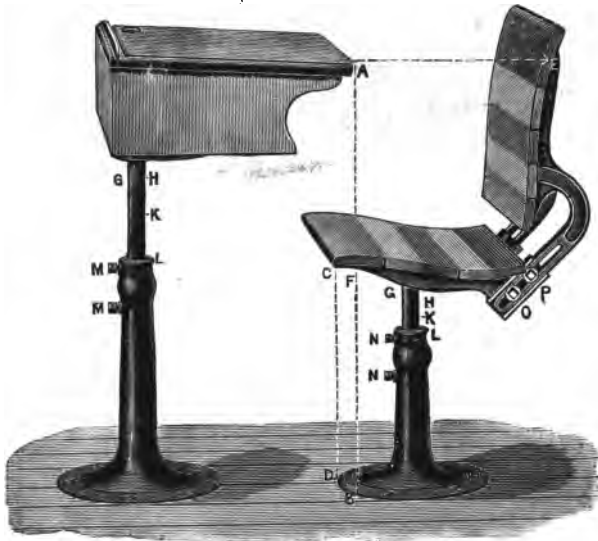


Figure 24.

farther from the desk, and the vertical for the purpose of setting it higher or lower, so as to be in a line with or below the shoulder blades of the occupant. Both adjustments are very important. In my designs I have provided means whereby this two-fold adjustment of the chair-back may be effected simultaneously by a single operation.

By loosening the bolts, *o-p*, the chair-back may readily be adjusted to any desired elevation, while on account of the angle or obliquity of the brackets in their relation to the seat, the chair-back will at the same time, and without requiring any separate adjustment, be moved rearwardly from the desk or seat to a distance which shall be commensurate or appropriate to its

degree of elevation. After the proper two-fold adjustment has been effected, the chair-back is secured firmly in its adjusted position simply by tightening the bolts, *o-p*.



Figure 25.

The above-described adjustable desk and chair possess the following advantages, viz.:

1st. They are adjustable in every desirable way, and each adjustment is entirely independent of the others, so that the exact hygienic requirements of each pupil may be provided for.

2d. None of the adjustments can be effected without the use of a wrench or key (in care of the teacher or any other authorized person) so that when the desk and chair have been once adjusted, they cannot be altered in any way by the pupil, but will stand in the position for an indefinite period of time.

3d. They are made very strong, and are constructed in the simplest manner possible. They can therefore be manufactured and placed upon the market at little expense.

4th. The bases being round and plain, they do not interfere with sweeping, and the school-room can be kept clean from dirt and dust which now accumulates on and between the brackets.

5th. They may be manufactured in but two sizes, which will meet the requirements of any school, and will accommodate scholars of any height and size without exception.

Size No. 1 is adapted to Primary, Intermediate and Grammar Schools. The desk can be adjusted to any height from 20 inches to  $28\frac{1}{4}$  inches, and the chair from 11 to  $16\frac{1}{2}$  inches; so as to suit scholars of any height from 3 ft. 4 in. to 5 ft. 4 in.

Size No. 2 is adapted to Intermediate, Grammar, High and Normal Schools, and Colleges. The desk can be adjusted to any height from  $23\frac{3}{4}$  inches to  $30\frac{1}{2}$  inches, and the chair from  $13\frac{1}{2}$  to 18 inches; so as to suit scholars of any height from 4 ft. 2 in. to 6 ft. 2 in.

As "seeing is believing," I invite particular attention to the accompanying cuts (Figures 26, 27, 28 and 29). They are reproductions from photographs taken from life, of persons of different heights, occupying an adjustable desk and seat adjusted for each occupant.

Figure.	Height of Occupant. Ft. In.	Height of Desk. Inches.	Height of Chair. Inches.	Width of Seating Space. Inches.
26	3-7 $\frac{1}{2}$	20 $\frac{1}{4}$	11 $\frac{1}{2}$	9 $\frac{1}{2}$
27	4-4	24 $\frac{1}{2}$	14	10 $\frac{1}{2}$
28	5-2	29	16 $\frac{1}{2}$	18
29	5-5 $\frac{1}{2}$	29 $\frac{1}{4}$	17 $\frac{1}{2}$	18

These four changes are, of course, but examples; the number of changes possible is unlimited, as both desk and seat may be moved vertically to any height required, and the chair-back may be moved vertically and horizontally. This latter movement is very important in adapting the seat to the use of girls, whose form and dress render it necessary to have greater space between the desk and the chair-back.





Figure 26.

Figure 26.

Height of occupant, - - 3 ft. 7½ in.  
 " desk, - - - 20¼ inches.  
 " seat, - - - 11½ "  
 Width of seating space, - 9¼ "



Figure 29.

Height of occupant, - 5 ft. 5½ in.  
 " desk, - - - 29¼ in.  
 " seat, - - - 17½ "  
 Width of seating space, 13 "

Figure 29.



Figure 28.

Figure 28.  
Height of occupant, - - 5 ft. 2 in.  
" desk, - - - 29 inches.  
" seat, - - - 16½ "  
Width of seating space, - 13 "



Figure 27.

Figure 27.  
Height of occupant, - - 4 ft. 4 in.  
" desk, - - - 24½ inches.  
" seat, - - - 14 "  
Width of seating space, - 10½ "

The following table was carefully prepared in accordance with the tables of Drs. Erismann and Farner, and compared with those recommended by the most prominent scientists, both of this country and of Europe. It will serve as a guide in setting up and adjusting the desks and seats, and may be implicitly relied upon.

SCALE NUMBERS.		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.	XV.
Height of Scholar in Inches . . .	{ From .	40	42	44	46	48	50	51½	53½	55½	57½	59½	61½	63½	65½	67½
	{ To . .	42	44	46	48	50	51½	53½	55½	57½	59½	61½	63½	65½	67½	and up.
Height of Desk, Line A-B (Figs. 23 and 24) . .		20	20½	21½	22½	23	23½	24½	25½	26	26½	27½	28½	29	29½	30½
Height of Chair, Line C-D . .		11	11½	12	12½	13	13½	14	14½	15	15½	16	16½	17	17½	18
Width of Seating Space, Line A-E . .		9	9½	9¾	9¾	10½	10½	10¾	11½	11½	11½	12½	12½	12½	13	13½

It is recommended that the desk for a girl should be about ¾ of an inch higher than that for a boy of the same height. The width of the seating space should be about ¾ of an inch greater for a girl than that for a boy.

**DIRECTIONS FOR USING THE TABLE.**—Measure the height of the scholar; then find in the table the number that most nearly corresponds to it, and directly under it in the same column will be found the figures required for the different adjustments.

**EXAMPLE.**—A boy is found to be 52 inches in height. In column VII., 51½-53½ are the nearest to it; looking down this column we find 24½ inches for the height of the desk, line A-B (Figs. 23 and 24), 14 inches for the height of the chair, line C-D, and 10½ inches for the space between the desk and the back of the chair, line A-E.

For greater convenience, however, I have designed a sliding scale (Figure 30), by the use of which, when the pupil's height is ascertained, the proper height for the desk and for the seat, and the proper distance between the desk and chair-back, can be read off from it at a single glance. The numbers on the scale correspond with those of the table.



Figure 30.

If an adjustable desk and seat is useful in the school-room, it is evidently no less valuable in the home of the pupil if he passes much time there at his studies. To meet this requirement an adjustable desk and chair may be set up on a platform, carpeted if desired, and on castors, to render it easily transportable.



Figure 31.

**DRAWING DESKS.**—In giving lessons in drawing in elementary schools, the ordinary desk will be found sufficient ; but

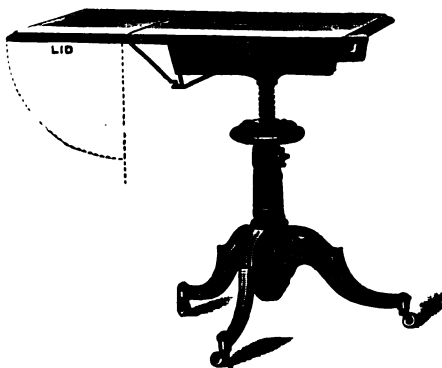


Figure 32.

in the advanced classes a properly constructed drawing-desk or easel will be found indispensable.

**TEACHERS' DESKS.**—Many forms of teachers' desks are in use. Any of them will answer the purpose if they have the following qualities: A large, level, table-like surface on the top, not less than two and a half feet wide by five feet long, with a ledge not higher than three or four inches at each end and the back, and a movable inclined surface for writing on, if desired. If the ledge is higher, it will interfere with the teacher's view of a class in front of him, and may impede the pupil's view of articles or experiments when exhibited on the desk; and the inclined writing surface should be movable, to leave the whole desk-top free for similar occasions. It should have no deep box or well, but drawers underneath or at the side, and shelves with doors, or both, always accessible without disturbing the articles necessarily placed on the top.

**TEACHERS' CHAIRS.**—The platform should have at least one large, comfortable and sedate-looking chair; not that the chair, or the desk, or any other part of the school-room furniture or apparatus will supply any defect in the teacher; but every proper means should be adopted to add to the respectability of his position, and the dignity of his office. The platform should also have several other chairs for visitors, and particularly for the board of trustees, who, when they visit the school, should always, during at least a portion of their stay, appear on the platform, and be seen and known in their official character. Children are naturally inclined to be much influenced by the presence of those in authority; and it is a great error in any system for the education of the people, whose laws and the agents of whose laws depend wholly on voluntary obedience, to weaken—or rather not to strengthen—this right feeling. This salutary habit of respect for the law and its officers will not only be strengthened by the official reception and presence of school trustees, but the teacher will find his heart cheered and his hands strengthened by their frequency. When it is known that this is a matter of periodical recurrence, it will be expected

and prepared for ; and when the rules of the school are understood to emanate from other authority, and their results to be reported to another tribunal, parents will have an additional motive for conformity, and pupils one more strong stimulant to progress.

**THE PLATFORM.**—In all contracts for the erection of school-houses, the platform should be included, and it should be ample and substantial. The north end of the main room has frequently been pointed out as the most desirable situation ; but this will depend on the position of the house and of the windows. The platform should extend across the whole end or side of the room where it is placed, if not curtailed by doors ; and it should be one full step higher than the floor, but probably two steps will be found equally useful for ordinary purposes, and more so in times of exhibition, etc.

No platform should be narrower than four feet, but five would be better, and six ample for all purposes.

**THE BLACKBOARD.**—By all competent teachers, the blackboard is known to be the most useful, and, next to seats and desks, the most indispensable article of school furniture. With a sufficiency of blackboard, the well-qualified, experienced teacher can do almost anything in the way of instruction ; without it, he feels himself at a loss in every branch. As to the quantity requisite, it may be said that it can readily be too little, but cannot well be too great. The whole wall behind the teacher's seat, and all the spaces between the windows and doors on the other walls, if covered with good black surface, extending five feet upwards, from a point two feet above the floor or platform, would not be too much ; but a blackboard of the height specified, and extending the whole length of the platform, is indispensable. This position faces the whole school, and is, therefore, the most suitable for the instruction of the whole at once ; while it is as proper as any other for the use of individual pupils.

*It is the author's desire to make this work as complete as possible, and any criticism or suggestion that may be offered on the subject will be thankfully received and appreciated.*







